MBTCR 9231T: Advanced Genetics, Biostatistics

Theory: CIA: 20 Marks; End-Sem: 80 Marks

No. of Credits	6
Theory/Composite	Theory
No. of periods assigned	6 Theory

Course description/objective:

The course is designed to

1. provide a comprehensive idea about population genetics for studying genetic variation and determining allelic frequencies in populations.
2. introduce the students to genetic screening for detection of human diseases, to the basics of gene therapy for treatment of the same and provide them with a comprehensive idea about the role of oncogenes and tumour suppressor genes in various kinds of cancers.
3. provide an advanced understanding regarding the use of genetics in conservation biology and in the design of conservation strategies for protection of endangered species.
4. empower the students with the basic idea of biostatistics and enable them to understand the procedure of executing the calculations.
5. enable the students to gain confidence in understanding which tests are to be applied on what kind of data.
6. familiarize students with use of R programming language and exposure to GWAS analysis which should enable the willing student to get hired in an industry set up since with the advent of big data in biology, skilled freshers with the ability to do basic coding and knowledge of population studies tend to get improved opportunities.

Syllabus:

Module A: Advanced Genetics (40 marks)   (3 classes/ week)

UNIT I: Population Genetics: Genetic variation in populations, the Hardy-Weinberg law, determination of allelic frequencies and testing a locus for Hardy-Weinberg equilibrium, effects of mutation, migration, genetic drift and natural selection on allele frequencies, heterozygote superiority, assortative mating.

UNIT II: Genetic Screening & Gene Therapy: Screening for genetic diseases: prenatal testing and newborn screening, molecular markers, testing using RFLP analysis and PCR based approaches. Gene therapy: types of gene therapy, delivery vehicles for gene therapy, gene therapy in humans.

UNIT III: The Genetics of Cancer: Cancers as genetic diseases, proto-oncogenes, cellular oncogenes and retroviral oncogenes, tumour suppressor genes, the roles of pRb and p53, tumour suppressor genes in breast cancer.

UNIT IV: Genetics in Conservation: Importance of genetic diversity in conservation, effects of genetic erosion, inbreeding and reduction in gene flow. Population augmentation strategies.

Module B: Biostatistics and Quantitative Genetics (40 marks)   **(3 classes/ week)**

UNIT V: Biostatistical Methods: Biostatistical terms, Sampling methods, statistical errors; χ^2 tests: degrees of freedom, simple, and contingency χ^2, application of χ^2 test; t-test: unpaired t-test (large sample and small sample), paired t-test; ANOVA: one way and two way, Correlation and Regression. Basic R commands for statistical analysis.

UNIT VI: Quantitative genetics: Nature and inheritance of continuous traits, polygene hypothesis, quantitative genetic analysis, heritability and its measurements, broad sense and narrow sense heritability. Role of Genome Wide Association Studies (GWAS).

Texts & Reading/Reference Lists:

Module A:

1) P. J. Russell. iGenetics- A Molecular Approach.

2) A.J.F. Griffiths, S.R. Wessler, R.C. Lewontin S.B. Carroll. An Introduction to Genetic Analysis.

3) B.K. Hall, B. Hallgrimsson. Strickberger's Evolution.

4) S. Rastogi, N. Pathak. Genetic Engineering.

5) S.B. Primrose, R.M. Twyman. Principles of Gene Manipulation & Genomics.

6) R.A. Weinberg. The Biology of Cancer.

7) Relevant scientific literature.

Module B:

8) P.J. Russell. Quantitative genetics: iGenetics–A Molecular Approach.

9) N.G. Das. Statistical methods Vol I & II.

10) Basic Biostatistics 2nd Edition B. Burt Gerstman

11) Basic Biostatistics for Geneticists and Epidemiologists; Elston Robert C

Q.Paper Structure for End SemTheory

Module A (40 marks):

Objective Questions: Answer any 5 out of 6 questions. 2x5 = 10 marks

Subjective Questions: Answer any 3 out of 5 questions (with subparts). 10 x 3 = 30 marks

Module B (40 marks):

Objective Questions: Answer any 10 out of 12 questions. 1x10 = 10 marks

Subjective Questions: Answer any 3 out of 5 questions (with subparts). 10 x 3 = 30 marks